

A New, Distinctively Colored Snake Eel (Anguilliformes: Ophichthidae) from Northeastern New Zealand¹

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ABSTRACT: *Quassiremus polyclitellum*, n. sp., described from three specimens line-fished at island outliers in 35–58 m represents the first record of *Quassiremus* Jordan & Davis, 1891, for the Indo-West Pacific. It has regularly spaced, mid-brown to orange, vertically rectangular saddles of pigment along body, tail longer than preanal length, and 166–168 vertebrae. It thus differs from East Pacific *Q. nothochir* (Gilbert), which has hourglass-shaped spots ringed with brown and 138–142 vertebrae, Galápagos endemic *Q. evionthas* (Jordan & Bollman) with small oblong spots and 149–153 vertebrae, and western Atlantic *Q. ascensionis* (Studer) with large, round spots above, alternating with similar spots below and 129–136 vertebrae; all three species have the tail shorter than the preanal length. The strong New World associations of *Quassiremus* are noted and the possible extralimital origins as larvae of the holotype and paratypes are discussed.

THE NEW ZEALAND EEL fauna comprises some 23 genera and 40 species, of which 15 species occur in the inshore and the remainder in deeper water. In contrast, the neighboring Australian eel fauna comprises 54 genera and 146 species (Paxton et al. 1989) though encompassing a much greater geographical and habitat range.

The relatively limited New Zealand inshore eel fauna has been known for many years, with only one or two recent additions. The collection, therefore, of the distinctive ophichthid species described here from two inshore locations that are relatively accessible and known to both commercial and amateur fishers is a remarkable discovery. This is especially so, biogeographically speaking, because it was only after a lengthy search of eel literature that it was determined to be a new species of *Quassiremus* Jordan & Davis, 1891, whose three known congeners occur distantly in the central East Pacific and western Atlantic.

The most distinctive feature of these eels is the prominently blotched to spotted body coloration. On that basis the first specimen to be collected (AIM 4021, off the far Northland east coast) tentatively was identified as the somewhat similarly colored *Myrichthys maculosus* (Cuvier, 1816), an ophichthid species widespread in the Indo-Pacific including Australia, Lord Howe Island, Norfolk Island, and the Kermadec Islands immediately to the north of New Zealand (Francis 1993). My cursory examination of the specimen showed that this identification was not correct. The species of *Myrichthys* Girard, 1859 (type species, the East Pacific *M. tigrinus* Girard), have molariform teeth on the roof of the mouth and jaws, dorsal origin well forward on the head, and a small, broad-based pectoral fin (McCosker and Rosenblatt 1993), whereas in the Northland specimen the teeth are sharp, the dorsal origin is level with the gill opening, and the pectoral is a tiny, inconspicuous flap. Furthermore, the body color of *M. maculosus* consists of widely spaced, relatively large, oval spots; in its other Indo-Pacific congener *M. colubrinus* (Boddaert, 1781) the head and body are marked by well-defined, widely spaced dark rings. The Northland specimen has large, closely packed, rec-

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tangular blotches and saddles, with the lower half of the body largely free of pigment. In the second and third specimens (NMNZ P.30897 and NMNZ P.32306, Mokohinau Islands, outer Hauraki Gulf) the body pigment is predominantly in the form of saddles separated by narrow spaces. *Myrichthys* is therefore readily excluded from consideration, for the above reasons.

Aside from the body coloration, the distinctive character of the three specimens is the very small pectoral fin, no more than a scarcely visible flap, though with a broad base almost matching the extent of the gill opening in front of it. Among the approximately 55 genera of Ophichthidae, loss or reduction (presumably) of the pectoral fin is not uncommon (McCosker et al. 1989). This applies to most of the 10 genera of Myrophinae and about 23 of the 42 genera of Ophichthinae. Reduction or loss of the pectoral fin has obvious functional importance in the fossorial mode of life of most ophichthids but in itself it is not a definitive character for members of any of the recognized tribes in this family. Within the Ophichthinae (snake eels), McCosker (1977) recognized four tribes, each having at least some genera in which the pectoral fin is reduced or absent.

The Bascanichthyini are extremely elongate eels with low median fins, dorsal origin forward on the head, and uniform coloration; the Sphagebranchini have ventral gill openings, low median fins, and uniform coloration; the Callechelyini have low gill openings and dorsal fin origin far forward on the head, but usually have robust striped and/or spotted bodies; the Ophichthini have lateral gill openings, dorsal origin farther back, but generally have robust, spotted bodies. The specimens reported here clearly belong in the Ophichthini, which, however, contains only three genera with a much-reduced pectoral: *Myrichthys*, *Evips* McCosker, 1972, and *Quassiremus* Jordan & Davis, 1891. *Myrichthys* has already been excluded by virtue of having molariform teeth, *Evips* has biserial maxillary teeth and two preopercular pores, and *Quassiremus* has uniserial maxillary teeth and three preopercular pores. The latter condition matches with the specimens reported

here and they are therefore referred to *Quassiremus*.

This genus is known currently from three species (McCosker et al. 1989). Allen and Robertson (1994) recently illustrated the two East Pacific species. *Quassiremus evionthas* (Jordan & Bollman, 1889), the type species, endemic to the Galápagos Islands, has the pectoral fin length about equal to eye diameter, upper half of the body covered with numerous oblong spots, each slightly smaller than the eye, and 149–153 vertebrae. *Quassiremus nothochir* (Gilbert, 1890), from the East Pacific, has a pectoral fin length less than eye diameter, 14–16 large, hourglass-shaped pale spots ringed with brown meeting at the dorsal midline as large ocelli, and 138–142 vertebrae. *Quassiremus ascensionis* (Studer, 1889), known from Bermuda to Ascension Island in the central western Atlantic, also has a minute pectoral, 16–20 dark spots or saddles, an alternating row of dark blotches below the lateral line, and 129–136 vertebrae.

The New Zealand specimens conform with *Q. ascensionis* and *Q. nothochir* in having an extremely small pectoral (i.e., smaller than that of *Q. evionthas*), but differ in body color pattern and in having 166–168 vertebrae. They also differ in having head and trunk (i.e., pre-anal length) contained 2.3–2.5 times in total length rather than 1.8–2.0 in total as it is in the East Pacific and Atlantic species. It is clear, therefore, that the material reported here belongs to a new species, described here.

MATERIALS AND METHODS

The holotype and paratypes are deposited as follows: Museum of New Zealand Te Papa Tongarewa, Wellington (NMNZ), holotype and paratype; Auckland Institute and Museum, Auckland (AIM), paratype. Comparative specimens also studied were from the California Academy of Sciences (CAS). Radiographs of the type specimens are currently held by the author but eventually will be deposited in the relevant institutions.

Measurements were made to the nearest 0.1 mm with dial calipers. Standard length and total length are the same in these specimens

because they lack a caudal fin; preanal length is the straight line distance between tip of snout and middle of anus; predorsal is snout tip to base of first dorsal fin-ray; head is from snout tip to uppermost extremity of branchial aperture (gill opening); snout is from snout tip to anterior margin of fleshy orbit; eye is greatest (horizontal) diameter of orbit; interorbital is least distance between dorsal margins of orbits; mouth is from snout tip to extremity of exposed maxilla where it becomes covered by integument (i.e., snout to rictus); branchial aperture is distance between upper and lower extremities; pectoral is measured from middle of base to its tip; depth is depth of body at anus. Total vertebral counts include the hypural complex as a separate element.

Quassiremus polyclitellum Castle, n. sp.
Figures 1 and 2

Myrichthys sp., Paulin and Stewart, 1985: 8 (Whangaroa Harbour, the smaller paratype).

Ophichthus sp., Paulin et al., 1989: 73 (Whangaroa Harbour, the smaller paratype).

DIAGNOSIS: A *Quassiremus* with ca. 45 medium brown to orange (in life), oval to vertically rectangular, wide saddles along body, the saddles separated by much narrower off-white bars that meet ventrally; the blotches progressively smaller and more rounded forward to snout and tail tips; pectoral fin a minute, scarcely visible fleshy flap; head and trunk (preanal distance) shorter than tail (i.e., 2.3–2.5 in SL); 166–168 vertebrae.

DESCRIPTION: Proportional measurements of holotype and (smaller paratype, larger paratype). Preanal 44.1 (40.6, 44.0) % SL; predorsal 20.5 (19.5, 19.4), head 17.8 (18.3, 18.1), both % preanal length; snout 24.7 (27.8, 23.3), eye 11.0 (12.1, 9.4), interorbital (18.8, 18.1), snout to rictus 37.1 (46.4, 46.0), branchial aperture 15.4 (14.2, 13.9), branchial interspace 35.6 (34.3, 34.0), pectoral 7.5 (8.6, 8.3), depth at anus 46.1 (43.9, 35.9), all % head length. Dorsal rays 340 (318, 348), dorsal rays before a vertical at level of anus 71 (67, 125), anal rays ca. 288 (285, 282), total lateral line pores 157 (–, –), predorsal vertebrae 7 (7, 8), pre-

anal vertebrae 68 (65, 70), total vertebrae 166 (167, 168). Head pores in holotype and smaller paratype: ethmoid 1 (1), supraorbital 3 (3), adnasal 0 (1), infraorbital 4 (4) including 2 postorbital, preoperculo-mandibular 6 + 3 (6 + 3), supratemporal 2 + 1 median with 1 pore immediately behind the median pore (2 + 1), frontal pore 1 (1), level with posterior eye margins. The fifth mandibular pore in the holotype appears as two small pores (i.e., it is doubled).

Body moderately elongate, somewhat laterally compressed anteriorly, round in cross-section and firm along tail. Snout short, relatively sharp, dorsal profile and that of head curving downward in front; lower jaw subequal to snout; anterior nostril tube prominent, broader toward its tip, equal in length to about 3/4 of eye diameter, directed downward immediately in front of tip of lower jaw; posterior nostril a horizontal slit, difficult to locate, opening entirely within mouth and visible only when mouth opened and its roof viewed from ventral aspect, the slit placed on fleshy edge of jaw external to maxillary dentition and level with second to third maxillary teeth, covered by a thin flap so that nostril opens medially across roof of mouth; mouth cleft extending to about an orbit diameter behind eye and curving downward to rictus; no lips but space between base of anterior nostril, base of intermaxillary teeth and front of maxilla with two rows of short papillae, the outermost row continuing along much of edge of maxilla; eye small, subcircular; head pores small but obvious, each with a well-marked rim. Head relatively short, set off somewhat from trunk by a slight expansion of fleshy branchial region; branchial aperture markedly oblique, equal to interorbital space; pectoral very small, fleshy, equal in length to anterior nostril; tail length noticeably greater than preanal length, anus thus placed well before midlength. Dorsal fin, when extended, a little less than body depth along most of body, its origin slightly behind level of posterior margin of branchial aperture and ending just short of caudal tip; anal fin much shallower than dorsal, ending level with posterior tip of dorsal fin; end of caudal region

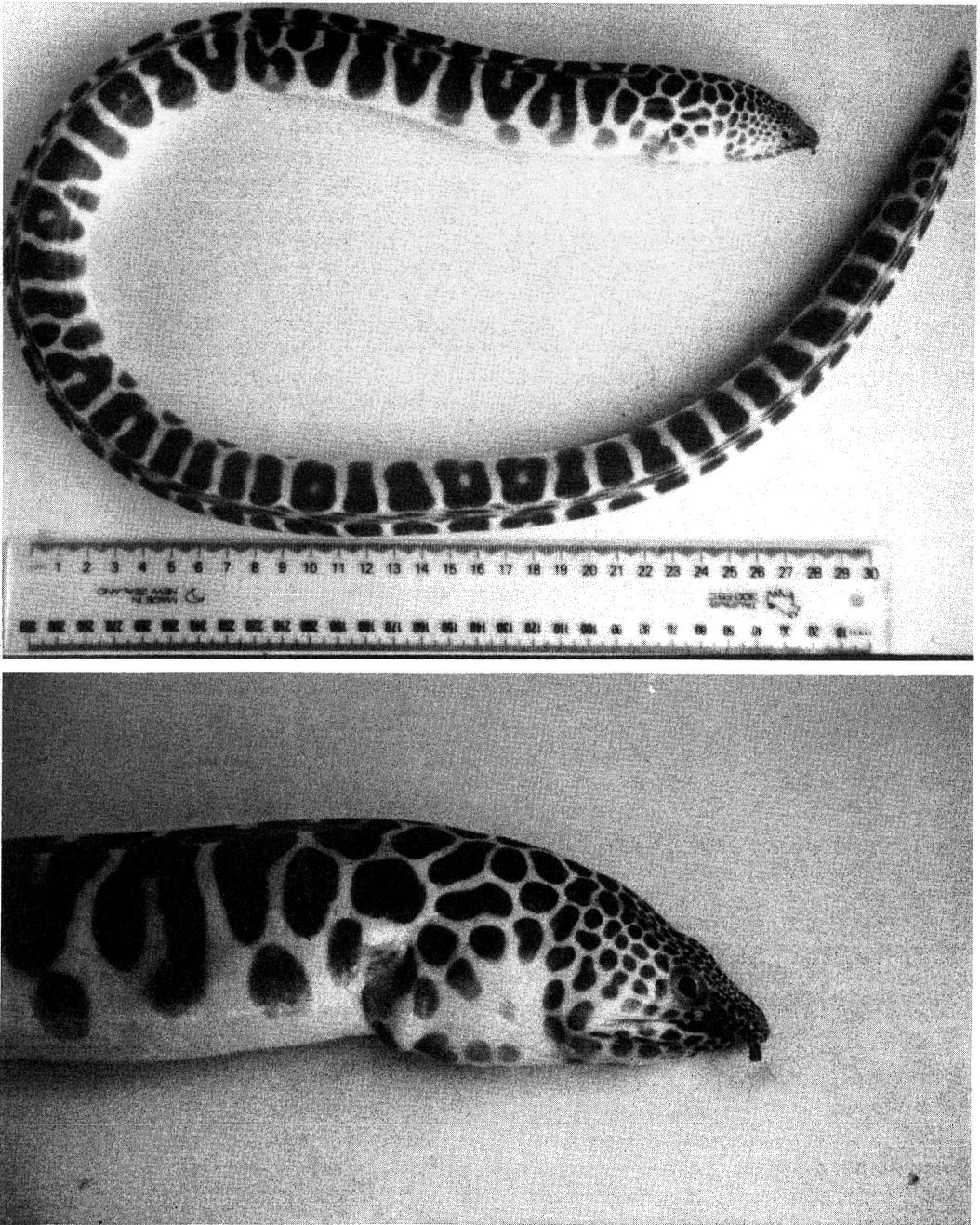


FIGURE 1. Holotype of *Quassiremus polyclitellum*, NMNZ P.30897, 750 mm SL, Mokohinau Islands: (top) photographed from the fresh specimen; (bottom) enlargement from the color slide. (Photographs: Malcolm Francis)

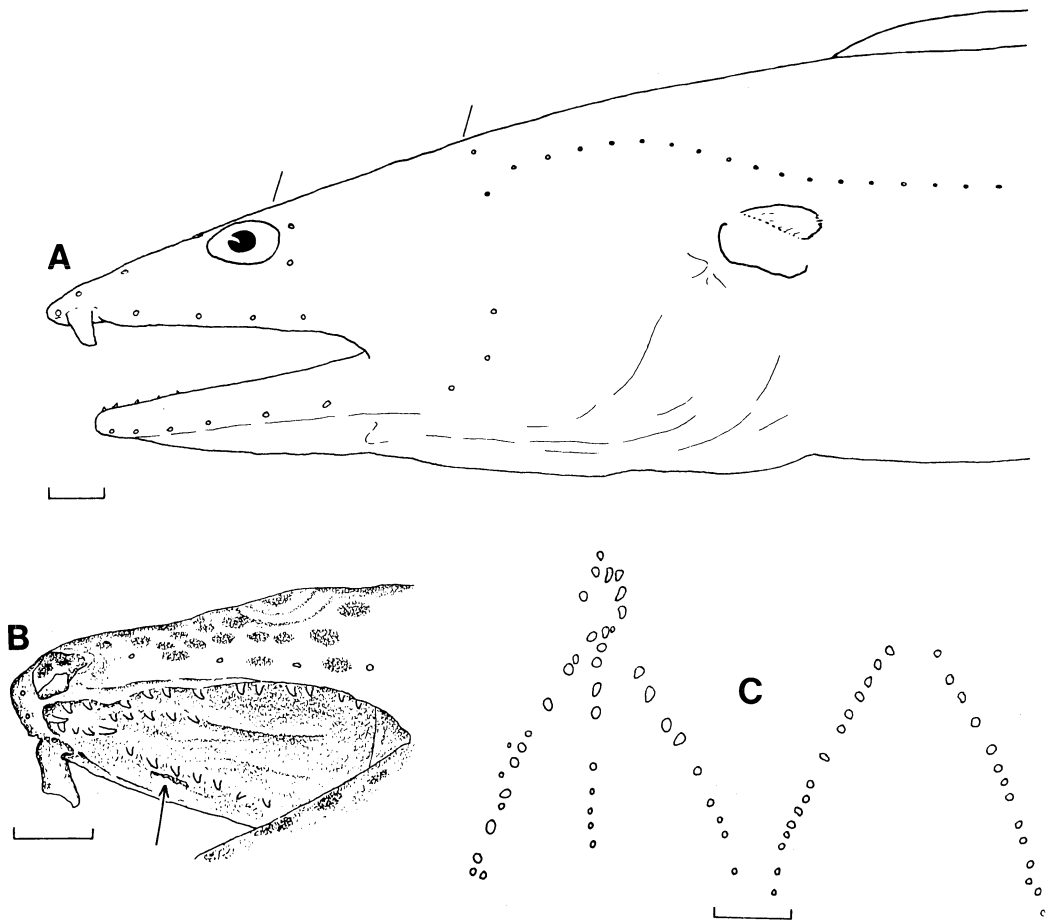


FIGURE 2. Holotype of *Quassiremus polyclitellum*, NMNZ P.30897, 750 mm SL, Mokohinau Islands. (A) Head region, body coloration not included, positions of frontal and median supratemporal head pores indicated. (B) Ventrolateral view of mouth showing intermaxillary, maxillary, and anterior vomerine teeth (posterior several vomerine teeth covered by fleshy folds), arrow indicates posterior nostril. (C) Pattern of upper (left) and lower (right) dentition as sketched from plasticene impressions. Scale bars each represent 5 mm.

relatively sharp, hard, without a caudal fin. Lateral line pores small but distinct, continuing to about 30 mm short of tail tip.

Teeth generally inconspicuous and largely obscured by edges of mouth (intermaxillary, maxillary, and mandibular) or by fleshy roof of mouth (vomer); intermaxillary with bases of 2 large teeth on left side, with evidence of a tooth pocket between them, on right side 4 large recurved teeth, the anteriormost loose and almost free, and 2 small teeth on front of intermaxillary; vomer with 7 uniserially arranged teeth, the first 2 almost level with one

another followed by a short gap and then 5 small teeth that are generally obscured in the preserved material by fleshy folds of palate; maxillary with about 13 more or less uniserial teeth on left side, each of size similar to those on vomer, on right side about 9 teeth; mandibular teeth about 14, uniserially arranged like those on vomer, posterior ones somewhat covered by fleshy bases.

Color (in alcohol): Highly distinctive, as follows: along entire body from branchial aperture to tail tip a series of about 45 medium-sized chocolate (dorsally) to orange

(ventrally) narrow saddles extending across dorsum, but not incorporating dorsal fin; these saddles ending below lateral line forward of anus, but just overlapping it behind anus. The saddles are in general moderately broad, but are separated by much narrower spaces; saddles not wholly regular in shape but here and there divided dorsally or ventrally and left and right halves not exactly matching across dorsal midline; some saddles partially divided to form separate, rounded spots dorsally. Ventrolateral and ventral surface creamish white with scattered, round, light chocolate spots alongside anal fin base, these spots merging into lateral surface near caudal tip. Forward of branchial aperture on dorsum of head across cheek onto snout and lower jaw the markings progressively become smaller, separate, rounded spots so that on tip of snout they are only about as large as pupil of eye; tail tip similarly spotted. A few faint, round spots on throat. Color when fresh: similar, but ventral portion of saddles and separate spots orange; iris orange.

In the smaller paratype (AIM 4021) the markings are much less definitely saddle-shaped and appear as dorsally and ventrally alternating generally broader, oval patches, alternately matching across the dorsum.

Holotype a maturing male with right testis larger than left; paratypes are also males. Holotype with a large fishhook in throat and two compressed, ovoid otoliths farther back in gut (from radiograph); larger paratype also with a large fishhook in throat. Subsequent to initial measurement and study, the smaller paratype became dried out through an oversight in curation, but is still readily recognizable and retains most of the characters described above.

TYPE MATERIAL: Holotype: NMNZ P.30897, 750 mm SL, male, Tiki Rocks, north side of Fanal Island, Mokohinau Islands group, North Island, New Zealand, 35° 56' S, 175° 09' E, 48 m, setline, P. Bendle and W. Cook, 2 April 1989. Paratype: AIM 4021, 643 mm SL, male, Stephenson Island, outer entrance to Whangaroa Harbour, North Island, New Zealand, 34° 58' S, 173° 47' E, 35 m, setline, P. Tane, 9 November 1981. Paratype: NMNZ

P. 32306, 795 mm SL, male, northwest side of Fanal Island, Mokohinau Islands group, North Island, New Zealand, 35° 56' S, 175° 09' E, 54–58 m, base of reef on rocky and sandy bottom, baited longline, Brett Campbell, 16 June 1995.

REMARKS: The specific name means literally “the many saddle,” in reference to the prominent saddle-shaped darker bars across the dorsum, and is a compound noun in apposition. It retains its original ending. The multiple, saddlelike to oval and separate markings readily distinguish this eel from all other eel species in the New Zealand and adjacent regions. Several species of Indo-Pacific morays (Muraenidae) are banded or spotted, including the southwest Pacific *Gymnothorax prionodon* Ogilby, 1895, but are dissimilar in familial characters and detail. In the Indo-West Pacific *Q. polyclitellum* might appear most like *Ophichthus erabo* (Jordan & Snyder, 1901) from Japan, but the latter has a well-developed pectoral, 143–155 vertebrae, and the coloration is less well organized (J. McCosker, pers. comm.). The only other species of relevance is *Ophichthus bonaparti* (Kaup, 1856) known from Indonesia to South Africa. This species has a well-developed pectoral, 157–163 vertebrae, and though the body coloration incorporates 18–27 prominent “saddles,” these are black, with golden marbling rather than small spots on the head (McCosker and Castle 1986).

In the absence of osteological information on the four species now known, it is not possible to speculate confidently on relationships. For comparative study I have had access to specimens of *Q. evionthas* (CAS 46540, Galápagos), *Q. nothochir* (CAS 62978, Baja California), and the description and illustrations of *Q. ascensionis* by McCosker et al. (1989). From this it is clear that the four *Quassiremus* species are united in having prominent and generally similar body coloration, though it is individually distinctive, and moderately to greatly reduced pectoral fins. *Quassiremus polyclitellum* is somewhat more like *Q. ascensionis* in body coloration than the profusely spotted *Q. nothochir* and *Q. evionthas* and more like both *Q. ascensionis* and *Q. no-*

thochir in having a comparably sized, minute pectoral than has *Q. evionthas*.

The three specimens were caught in quite similar circumstances (by setline in moderately deep water over rocky ground), but distant in locality and time. One paratype was caught first (1981), at Stephenson Island, off the entrance to Whangaroa Harbour, a somewhat remote rocky harbor off the far northeastern coast of Northland. The holotype was caught 8 yr later at an isolated rocky island group in the outer Hauraki Gulf near Auckland, and the second paratype was caught nearby very recently (1995). At both localities, morays (Muraenidae) are often caught along with other fishes that typically frequent rocky ground, though *Q. polyclitellum*, being an ophichthid, could be expected to require at least a partially soft substrate in which it could burrow tail first.

The discovery in New Zealand waters of *Quassiremus*, far removed from the western Atlantic and central East Pacific where it has hitherto been known, suggests that it has tethyan relationships rather than being simply a New World endemic. However, there are clearly strong New World associations for *Quassiremus* in the presence there of a central eastern Pacific, northeastern Pacific, and Caribbean/West Atlantic species. Should a southeastern Pacific species be discovered, which is not unlikely, all things considered, the association would prove to be much stronger.

At the species level, the apparent rarity of *Q. polyclitellum* suggests a likely origin further afield for the specimens reported here rather than that they are indicative of an established population in northeastern New Zealand of a previously overlooked but permanent member of the New Zealand fish fauna. Accordingly, it is possible that the holotype and paratypes were stragglers from a more northern source either as adults or as larvae. Possible sources might have been Norfolk Island or the Kermadec Islands, which lie at about 30° S latitude ca. 1000 km north of New Zealand. However, surface flow at that latitude in the area of these island groups tends to be more to the east, which would not favor transport to northern

New Zealand. A more likely source would therefore seem to be Lord Howe Island farther to the west and more or less directly in the upcurrent path of the eastward meander of the East Australian Current, which disperses across the northern Tasman Sea, around North Cape of New Zealand, and follows the line of the northeastern coast offshore as the East Auckland Current (Stanton 1981).

Francis and Evans (1993) reviewed the possible role of the East Auckland Current in sporadically bringing subtropical and tropical organisms (mainly fishes) to northeastern waters. Those authors concluded that the fundamental influence was the El Niño–Southern Oscillation (ENSO) operating through a positive Southern Oscillation Index (i.e., during La Niña periods) when onshore winds on this coast are common. These winds drive warmer water of the East Auckland Current coastward, carrying with them extralimital larvae. Major events of this type apparently occurred in the mid-1970s and again in 1988–1990. Such a dispersal pathway for *Q. polyclitellum* leptocephali from the suggested source locations would certainly not be beyond their capabilities, because the larval life of ophichthid leptocephali, in general, is probably at least about 3 months and possibly as long as 1 yr (Castle 1965). The leptocephalus of *Quassiremus*, specifically *Q. ascensionis*, has been tentatively identified (Leiby 1989) from specimens collected off Florida and in the Caribbean. However, among the various large collections of eel larvae from the southwestern Pacific that I have examined there is none that agrees in general characters with those described by Leiby (1989).

Consideration was given to extracting otoliths from the specimens in an attempt to determine their ages. This may have provided a match of ages with one or other of the “immigration” events referred to above. Because the holotype and smaller paratype were originally fixed in formalin, it is unlikely that satisfactory results could have been achieved and it was considered best to leave the specimens intact. There was not time to process the recently collected larger paratype for the otoliths.

KEY TO THE SPECIES OF *Quassiremus*

- 1a. Preanal length (i.e., head and trunk combined) 2.3–2.5 in total length; body coloration as large dark saddles on upper half, the saddles meeting across dorsal midline; pectoral fin length much less than eye diameter; total vertebrae more than 160 *polyclitellum* Castle, n. sp. (northeastern New Zealand)
- 1b. Preanal length 1.8–2.0 in total length; body coloration as small to large, pale to dark spots or saddles on upper half, the saddles meeting across dorsal midline, with an alternating row present or absent on lower half; pectoral fin length much less than to greater than eye diameter; total vertebrae fewer than 160 2
- 2a. Pectoral fin length equal to or greater than eye diameter; body coloration as numerous oblong spots on upper half, each slightly smaller than eye; total vertebrae 149–153 *evionthas* (Jordan & Bollman, 1889) (eastern Pacific, Galápagos Islands endemic)
- 2b. Pectoral fin length less than eye diameter; body coloration as large brown spots, mostly larger than eye; total vertebrae 129–142 3
- 3a. Body coloration as 14–16 large hourglass-shaped pale spots, ringed with brown, meeting at dorsal midline as large ocelli; total vertebrae 138–142 *nothochir* (Gilbert, 1890) (eastern Pacific)
- 3b. Body coloration dark dorsally, pale ventrally with 16–20 dark spots or saddles, meeting at dorsal midline, an alternating row of dark spots or blotches below lateral line; total vertebrae 129–136 *ascensionis* (Studer, 1889) (central western Atlantic)

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